
Locally Developed Compulsory Credit Courses
Grades 9 and 10

Science

Acknowledgment

Locally Developed Compulsory Credit (LDCC) Courses

These Locally Developed Compulsory Credit courses were developed by the LDCC Project coordinated by the Council of Ontario Directors of Education (CODE) in liaison with the Institute for Catholic Education (ICE), through a Consortium led by the Peel District School Board.

LDCC courses are intended to meet educational and career preparation needs of students that cannot be met by the courses authorized by the provincial curriculum policy documents. Funding for the development of these courses was provided by the Ministry of Education.

Boards who wish to offer these LDCC courses must follow the approval process for locally developed credit courses and submit the necessary approval form to their respective Ministry of Education District Office. These courses have been reviewed by the Ministry of Education for use by school boards and therefore, the processing of the school board approval will be expedited.

For further information on the development of Locally Developed Courses see: *Guide to Locally Developed Courses, Grades 9-12, Development and Approval Procedures*, 2004.

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Introduction

Purpose and Goals of Locally Developed Compulsory Credit (LDCC) Science Courses

The Locally Developed Compulsory Credit courses in science focus on the knowledge and skills that students need to be well prepared for success in the Grade 11 Science Workplace Preparation course. To request approval to offer these courses, school boards should contact their respective Ministry of Education District Office to obtain the necessary form. These courses have already been reviewed by the ministry and, therefore, the processing of the school board approval will be expedited.

Students with widely ranging levels of competency may require these science courses; some of these students may be up to four years behind grade level with significant gaps in knowledge, conceptual understandings, and skills. LDCC science courses support students in developing and enhancing strategies that they need to be competent readers and writers of scientific material (e.g., technical language, formulae, symbols, and other scientific text).

Opportunities to develop, enhance, and practise literacy, and mathematical literacy processes, concepts, skills, and strategies are critical in strengthening students' learning in all subject areas and preparing them for later success. Learning expectations in LDCC science courses interconnect skills in subject-area learning, literacy, and mathematical literacy. In this way, students taking LDCC science courses are given opportunities to improve their subject-area knowledge and skills and to practise using them in order to strengthen their literacy and mathematical literacy skills.

LDCC science learning expectations challenge students to examine their conceptual understandings, develop and enhance their critical-thinking skills, and engage in meaningful dialogue.

For students who successfully complete LDCC science courses, opportunities for lateral moves to other types of courses can be provided, as appropriate.

Rationale

The LDCC science courses were developed with the underlying rationale of developing science inquiry skills and conceptual understandings. The expectations in the Science Inquiry strand and in the skills sections of the other strands are intended to lead to success in the science inquiry skill expectations stated for the Grade 11 Science Workplace Preparation course. For all strands, the expectations for Understanding Basic Concepts and for Developing Skills of Inquiry and Communication support achievement of the Science, Technology, Society, and the Environment (STSE) expectations to ensure relevant contexts for the learning. The content focus in each strand is designed to prepare students for the topics in the Grade 11 Science Workplace Preparation course. All strands have an underlying theme of individual and personal contexts for learning. The intent is that students are provided with multiple opportunities to address the learning expectations thoroughly.

Curriculum Expectations

The expectations identified for these LDCC science courses describe the knowledge and skills that students are expected to develop and demonstrate in the various activities through which their achievement is assessed and evaluated.

For each course, two sets of expectations are listed for each *strand*, or broad curriculum area. The *overall expectations* describe in general terms the knowledge and skills that students are expected to demonstrate by the end of the course. The *specific expectations* describe the expected knowledge and skills in greater detail. The specific expectations are organized under subheadings that reflect particular aspects of the required knowledge and skills and that may serve as a guide for teachers as they plan learning activities for their students. The organization of expectations in strands and sub-groupings is not meant to imply that the expectations in any one strand or groupings are achieved independently of the expectations in the other strands or groupings.

Many of the expectations are accompanied by examples, given in parentheses. These examples are meant to illustrate the kind of skill, the specific area of learning, the depth of learning, and/or the level of complexity that the expectation entails. They are intended as a guide for teachers rather than as an exhaustive or mandatory list.

Strands

Each LDCC science course is divided into four strands.

Grade 9 LDCC Science	Grade 10 LDCC Science
<ul style="list-style-type: none"> Scientific Inquiry: Science in Daily Life Chemistry: Properties of Common Materials Biology: Staying Alive Physics: Electrical Circuits 	<ul style="list-style-type: none"> Scientific Inquiry: Science in Media Chemistry: Interactions of Common Materials Biology: Living Together Physics: Using Electrical Energy

Teaching Approaches

Teachers use their professional judgement to decide which instructional methods will be most effective in promoting the learning of core knowledge and skills described in the learning expectations. The LDCC science courses should introduce a rich variety of activities that provide students the opportunity to close gaps and build on their knowledge and conceptual understandings. The following strategies should be emphasized:

- using before-learning, during-learning and after-learning tasks;
- connecting the students' existing science knowledge to new concepts;
- using technologies (hand-held and ministry-licensed software);
- providing opportunities to organize information; and
- using visual aspects of learning, listening and talking, reading and viewing, and writing to understand concepts, organize ideas, and communicate scientific reasoning.

A solid conceptual foundation is essential for students if they are to learn and apply science concepts. Teachers play a critical role in judging the conceptual understanding of each student and in helping students with gaps in their learning retrace their thinking back to the point where meaning became lost. Establishing a rich environment for students to explore science concepts at the appropriate level and to use oral language to explain their thinking will enable students in LDCC courses to clarify their science conceptual understandings. By stressing conceptual understanding, presenting science ideas in multiple ways, and using relevant situations to apply concepts and promote classroom discussions, teachers are able to target instruction to the needs of the learners.

Building Scientific Literacy

To be scientifically literate is to be able to use science knowledge and skills to address problems that arise in daily life. Building scientific literacy for students in LDCC courses involves providing them with critical knowledge, including terminology that will be useful in their daily lives, at home, in their workplaces, and in their communities. It also involves helping them to develop and apply the inquiry skills of science: asking questions, planning and conducting investigations, gathering information, analysing data, and communicating findings. The development of these skills provides a meaningful and practical context in which students can also refine their literacy and mathematical literacy skills.

Building Literacy Skills

In the Preface to *Think Literacy: Cross-Curricular Approaches: Grades 7-12*, it is stated that literacy skills are at the heart of learning. Successful students are able to read for meaning, to write with clarity and purpose, and to participate productively in classroom discussions. But many students may be struggling with these skills, and that makes it more difficult for teachers to get to the content in the various subject areas. Research and classroom experience show that the most effective way to help struggling learners is to incorporate proven instructional strategies in every classroom. Students who are explicitly taught a repertoire of reading, writing, and oral communication skills, and become adept at using them, are then able to apply those skills in other contexts.

The solution offered is teamwork – a whole-school, cross-curricular approach to literacy learning. When teachers of all subjects use the same proven strategies to help their students read and write in the language of their subject discipline, they build on their students' prior knowledge and equip them to make connections that are essential for continued learning. This teaching doesn't require "time out" from content-area instruction. It happens side-by-side with content acquisition.* When math teachers demonstrate how to help students solve complex math problems, these skills also prepare them to read any subject text more effectively. When science teachers use a *web* or *concept map* to hypothesize about an ecosystem, they reinforce literacy strategies for students.

For students in LDCC courses, the more reinforcement they receive the better – students learn that reading, writing, and oral communication strategies work in all classrooms and that there is some common terminology as well as subject-specific vocabulary.

* *Think Literacy Success Grades 7–12: The Report of the Expert Panel on Students at Risk in Ontario*, 2003.

Building on Oral Language Skills

Oral skills – both talking and listening – are at the very foundation of literacy. Classroom talk helps students to learn, to reflect on what they are learning, and to communicate their knowledge and understanding. Oral communication strategies can help teachers obtain more precise information about what their students know and can do. This can also help teachers to provide better feedback and guidance to support student learning.

Teachers can help students strengthen their communication skills and conceptual understandings by presenting concepts in multiple formats and by encouraging group discussion about the concepts before students begin work on a task. Oral language experiences in large and small groups provide opportunities for students to clarify their thinking and to share these understandings with others.

Limited vocabulary and language structure may be evident among many of the LDCC learners. They may need help with key words required to communicate science ideas and ample opportunities to use science vocabulary in conversation. Group conversations using scientific terminologies enable students to expand their understanding of science terms and definitions. As they strengthen their understanding of science terms and definitions, they gain confidence in reading and discussing science-related text.

Developing Reading and Viewing Skills

As students progress through school, they are asked to read and view increasingly complex information and graphical texts in their courses. The ability to understand and use the information in these texts is key to a student's success in learning. Successful students have a repertoire of reading and viewing strategies to draw upon and know how to use them in different contexts.

Students in LDCC science courses may not have a wide range of strategies for reading and viewing science text. Because they might not see themselves as able to read very well, they often lack the confidence to try to interpret data or to read technical information prior to working with the material. Providing opportunities for the use of pre-reading or pre-viewing strategies enables students to strengthen their ability to understand science text. Students gain confidence in their scientific skills when they work with tasks that are connected to their experiences and lives, when they go through the process of generating and organizing information and conferring with others about strategies, and when they become accustomed to the use of before-learning, during-learning, and after-learning strategies (e.g., defining science terms, explaining their thinking). All of these strategies, when used regularly, help to strengthen students' comprehension skills.

Developing Writing Skills

Students are sometimes confused by differences in writing requirements from subject to subject. Although different subjects require different types of writing assignments, all writing can follow the same process. By adopting a consistent writing process across all subject areas, teachers ease some of the stress associated with writing and help students build confidence and skill as writers.

Integrating Reading, Viewing, and Writing Skills

Reading, viewing, and writing skills are complementary and mutually reinforcing. For this reason, some of the expectations require students to demonstrate their learning through activities that involve reading, viewing, and writing.

Teachers need to support and enhance these connections by introducing a rich variety of science activities that integrate reading, viewing, and writing and that provide opportunities for students to develop and practise these skills in conjunction with one another. These science activities should involve a range of authentic texts such as product labels, manuals, workplace regulations, diagrams, instructions, websites, posters, and brochures.

Building Mathematical Literacy Skills

Mathematics is a fundamental human endeavour that empowers individuals to describe, analyse, and understand the world we live in.* Mathematical literacy involves more than executing procedures. It implies a knowledge base and the competence and confidence to apply this knowledge in the practical world. A mathematically literate person can estimate; interpret data; solve day-to-day problems; reason in numerical, graphical, and geometric situations; and communicate using mathematics. Opportunities to practise these skills occur naturally in all subjects.

Mathematical literacy is as important as proficiency in reading and writing. Mathematics is so entwined with today's way of life that we cannot fully comprehend the information that surrounds us without a basic understanding of mathematical ideas. Confidence and competence in mathematics lead to productive participation in today's complex information society, and they open the door to opportunity. Teachers in science and other disciplines can create opportunities to help students appreciate the part that mathematics plays in their lives. Teachers should support mathematical literacy by conveying the belief that all students can and should do mathematics.

** Leading Math Success – Mathematical Literacy, Grades 7–12: The Report of the Expert Panel on Student Success in Ontario*

Building Essential Skills

Essential Skills are generic skills used in the workplace, in everyday life, and for lifelong learning. The Ontario Skills Passport provides clear descriptions of skills used in virtually all occupations, as well as a list of important work habits.

Teachers can help students to develop these Essential Skills – reading, writing, use of documents, use of computers, money math, data analysis, problem solving, finding information, job task planning, measurement and calculation, numerical estimation, oral communication, decision making, scheduling and budgeting, and accounting.

The ministry has developed two new courses under the Guidance and Career Education curriculum — *Discovering the Workplace*, Grade 10, Open, and *Navigating the Workplace*, Grade 12, Open. These courses provide students with the opportunity to learn about and demonstrate workplace Essential Skills and work habits.

Building Confidence

Students taking these courses may be doubtful that they can acquire the science skills they need to function effectively at school, at work, and in other everyday contexts. In seeking to meet the needs of these students, teachers should create a positive classroom environment and community of learners that give students the confidence to take risks as they learn and that continually encourage them to persist and improve. Students should engage in active inquiry to develop and/or enhance metacognitive skills that facilitate independence in learning.

To help students build confidence and to promote learning, teachers should use the approach of grouping students for purposes of instruction and support. Groupings should be flexible and should change as students' skills improve. Students may be grouped in a variety of ways, including:

- by instructional need (e.g., group students who need to practise a specific skill);
- by ability to read at a comparable level of challenge (e.g., select materials on the same topic but at different levels of difficulty, and group students to read the materials that are appropriate to their skills);
- by shared interest in particular topics or issues (e.g., group students to generate ideas as a team before they investigate a topic of shared interest);
- for purposes of effective collaboration (e.g., group students who can provide support for one another as they learn).

Assessment and Evaluation of Student Achievement

Basic Considerations

The primary purpose of assessment and evaluation is to improve student learning. Information gathered through assessment helps teachers to determine students' strengths and weaknesses in their achievement of the curriculum expectations in each subject in each grade. This information also serves to guide teachers in adapting curriculum and instructional approaches to students' needs and in assessing the overall effectiveness of programs and classroom practices. Students need multiple opportunities and a variety of ways to demonstrate their understanding for assessment and evaluation purposes.

Assessment is the process of gathering information from a variety of sources (including assignments, demonstrations, projects, performances, and tests) that accurately reflects how well a student is achieving the curriculum expectations in a subject. As part of assessment, teachers provide students with descriptive feedback that guides their efforts towards improvement. Evaluation refers to the process of judging the quality of student work on the basis of established criteria, and assigning a value to represent that quality. In Ontario secondary schools, the value assigned will be a percentage grade.

Assessment and evaluation is based on the learning expectations in LDCC course and on the achievement levels. See <http://www.edu.gov.on.ca/eng/document/policy/achievement/charts1to12.pdf>.

In order to ensure that assessment and evaluation are valid and reliable, and that they lead to the improvement of student learning, teachers must use assessment and evaluation strategies that:

- address both what students learn and how well they learn;
- are based both on the categories of knowledge and skills and on the achievement level descriptions given in the Achievement Chart for science;
- are varied in nature, administered over a period of time, and designed to provide opportunities for students to demonstrate the full range of their learning;
- are appropriate for the learning activities used, the purposes of instruction, and the needs and experiences of the students;
- are fair to all students;

- accommodate the needs of exceptional students, consistent with the strategies outlined in their Individual Education Plan;
- accommodate the needs of students who are learning the language of instruction (English or French);
- ensure that each student is given clear directions for improvement;
- promote students' ability to assess their own learning and to set specific goals;
- include the use of samples of students' work that provide evidence of their achievement;
- are communicated clearly to students and parents/guardians at the beginning of the school year and at other appropriate points throughout the year.

All curriculum expectations must be accounted for in instruction, but evaluation focuses on students' achievement of the overall expectations. The overall expectations are broad in nature, and the specific expectations define the particular content or scope of the knowledge and skills referred to in the overall expectations. A student's achievement of the overall expectations, as represented by his or her achievement of related specific expectations, must be evaluated. Teachers will use their professional judgement to determine which specific expectations should be used to evaluate achievement of the overall expectations, and which ones will be covered in instruction and assessment (e.g., through direct observation) but not necessarily evaluated.

The characteristics given in the Achievement Chart for level 3, which is the "provincial standard" for the grade, identify a high level of achievement of the overall expectations. Students achieving at level 3 in a particular grade can be confident that they will be prepared for work at the next grade. Level 1 identifies achievement that falls much below the provincial standard, while still reflecting a passing grade. Level 2 identifies achievement that approaches the standard. Level 4 identifies achievement that surpasses the standard. It should be noted that achievement at level 4 does not mean that the student has achieved expectations beyond those specified for a particular grade. It indicates that the student has achieved all or almost all of the expectations for that grade, and that he or she demonstrates the ability to use the knowledge and skills specified for that grade in more sophisticated ways than a student achieving at level 3.

Categories of Knowledge and Skills

The categories, defined by clear criteria, represent four broad areas of knowledge and skills within which the subject expectations for any given grade are organized. The four categories should be considered as interrelated, reflecting the wholeness and interconnectedness of learning.

See <http://www.edu.gov.on.ca/eng/document/policy/achievement/charts1to12.pdf>.

The Achievement Chart for Science

The Achievement Chart for science identifies four categories of knowledge and skills in science. The Achievement Chart is a standard province-wide guide to be used by teachers. It enables teachers to make judgments about student work that are based on clear performance standards and on a body of evidence collected over time. See <http://www.edu.gov.on.ca/eng/document/policy/achievement/charts1to12.pdf>.

The Achievement Chart is designed to:

- provide a framework that encompasses all curriculum expectations for the subject represented in this document;
- guide the development of assessment tasks and tools (including rubrics);
- help teachers to plan instruction for learning;
- assist teachers in providing meaningful feedback to students;
- provide various categories and criteria with which to assess and evaluate student learning.

The Achievement Charts for all disciplines, Grades 1–12, are currently being reviewed as part of the Sustaining Quality Curriculum (SQC) process and are being revised to improve consistency across grades and disciplines.

See <http://www.edu.gov.on.ca/eng/document/policy/achievement/charts1to12.pdf>.

Please refer to the Achievement Chart in *The Ontario Curriculum, Grades 9 and 10 Science*, 1999, which was used in the development of the Locally Developed Compulsory Credit Science courses.

Some Considerations for Program Planning in LDCC Science Courses

Teachers who are planning a program for LDCC Science must take into account considerations in a number of important areas. Essential information that pertains to all disciplines is provided in *The Ontario Curriculum, Grades 9 to 12: Program Planning and Assessment*, 2000. Information that pertains to the development of essential literacy skills is provided in *Think Literacy Success, Grades 7–12: The Report of the Expert Panel on Students at Risk in Ontario*, 2003. Information that pertains to the development of essential mathematical literacy skills is provided in *Leading Math Success – Mathematical Literacy, Grades 7–12: The Report of the Expert Panel on Student Success in Ontario*, 2004. All of these resources can be found on the ministry website at www.edu.gov.on.ca. Considerations relating to program planning in LDCC Science are noted here.

Education for Exceptional Students

In planning locally developed compulsory credit courses for exceptional students, teachers should begin by examining both the curriculum expectations for the course and the needs of the individual student to determine which of the following options is appropriate for the student:

- no accommodations* or modifications; or
- accommodations only; or
- modified learning expectations, with the possibility of accommodations.

If the student requires either accommodations or modified expectations, or both, the relevant information, as described in the following paragraphs, must be recorded in his or her Individual Education Plan (IEP). For a detailed discussion of the ministry's requirement for IEPs, see *Individual Education Plans: Standards for Development, Program Planning, and Implementation*, 2000 (referred to hereafter as *IEP Standards*, 2000). More detailed information about planning courses for exceptional students can be found in Part E of *Special Education: A Guide for Educators*, 2001. Both documents are available at www.edu.gov.on.ca.

* “Accommodations” refers to individualized teaching and assessment strategies, human supports, and/or individualized equipment.

Students Requiring Accommodations Only

With the aid of accommodations alone, some exceptional students are able to participate in the regular course curriculum and to demonstrate learning independently. (Accommodations do not alter the provincial curriculum expectations for the course.) The accommodations required to facilitate the student's learning must be identified in his or her IEP (see *IEP Standards*, 2000, page 11). A student's IEP is likely to reflect the same accommodations for many, or all, courses.

There are three types of accommodations. *Instructional accommodations* are changes in teaching strategies, including styles of presentation, methods of organization, or use of technology and multimedia. *Environmental accommodations* are changes that the student may require in the classroom and/or school environment, such as preferential seating or special lighting. *Assessment accommodations* are changes in assessment procedures that enable the student to demonstrate his or her learning, such as allowing additional time to complete tests or assignments or permitting oral responses to test questions (see page 14 of *IEP Standards*, 2000, for more examples).

If a student requires “accommodations only” in the locally developed compulsory credit course, assessment and evaluation of his or her achievement will be based on the appropriate course curriculum expectations and the achievement levels outlined in this document.

Students Requiring Modified Expectations

Some exceptional students will require modified expectations, which differ from the regular LDCC course expectations. For most secondary school courses, modified expectations will be based on the regular curriculum expectations for the course but will reflect changes to the number and/or complexity of the expectations.

Modified expectations must indicate the knowledge and/or skills the student is expected to demonstrate and have assessed in each reporting period (*IEP Standards*, 2000, pages 10 and 11). For secondary school courses, it is important to monitor, and to reflect clearly in the IEP, the *extent* to which expectations have been modified. As noted in Section 7.12 of the ministry’s policy document *Ontario Secondary Schools, Grades 9 to 12: Program and Diploma Requirements*, 1999, the principal will determine whether achievement of the modified expectations constitutes successful completion of the course, and will decide whether the student is eligible to receive a credit for the course. This decision must be communicated to the parents/guardians and the student.

When a student is expected to achieve most of the curriculum expectations for the course, the IEP should identify which expectations will not be assessed and evaluated. When modifications are so extensive that achievement of the learning expectations is not likely to result in a credit, the expectations should specify the precise requirements or tasks on which the student’s performance will be evaluated and which will be used to generate the course mark recorded on the Provincial Report Card. The student’s learning expectations must be reviewed in relation to the student’s progress at least once every reporting period, and must be updated as necessary (*IEP Standards*, 2000, page 11).

If a student requires modified expectations for the Locally Developed Compulsory Credit course, assessment and evaluation of his or her achievement will be based on the learning expectations identified in the IEP and on the achievement levels outlined in this document. If some of the student’s learning expectations for a course are modified but the student is working towards a credit for the course, it is sufficient simply to check the IEP box on the Provincial Report Card. If, however, the student’s learning expectations are modified to such an extent that the principal deems that a credit will not be granted for the course, the IEP box must be checked and the appropriate statement from the *Guide to the Provincial Report Card, Grade 9-12* must be inserted. The teacher’s comments should include relevant information on the student’s demonstrated learning of the modified expectations, as well as about next steps for the student learning in the course.

The Role of Technology in the Curriculum

In science, students gain hands-on experience with technology in the laboratory. Apparatus as diverse as digital balances and volumetric apparatus in chemistry, microscopes and Petri dishes in biology, and air tables and ammeters in physics provide the kinesthetic learner with unique learning experiences. Computers can be used in science to support laboratory investigations; for example, electronic probes can be used to monitor variables such as temperature, pH, and velocity. Computer programs can also be used to process class data and to simulate environmental or industrial scenarios, or animal dissections. Care must be taken, however, to ensure that computer-assisted laboratory programs are not used in situations where students' own technical skills should be developed, such as in analysing and graphing data. Computer-assisted laboratory programs should support students as they acquire knowledge and consolidate critical-thinking skills.

The Internet is a particularly valuable source of scientific information that students should be taught to access. In addition, some programs enable students to conduct scientific investigations and then use the tools of electronic communication to compare their results and analyses with those of students in other parts of Canada and around the world.

English as a Second Language and English Literacy Development (ESL/ELD)

Young people whose first language is not English enter Ontario secondary schools with diverse linguistic and cultural backgrounds. Some may have the experience of highly sophisticated educational systems while others may have had limited formal schooling. All of these students bring a rich array of background knowledge and experience to the classroom, and all teachers must share in the responsibility for their English-language development.

Teachers of science must incorporate appropriate strategies for instruction and assessment to support the success of the ESL and ELD students in their classrooms. Teachers can:

- make modifications to expectations (e.g., modification of some or all of the course expectations based on the student's level of English proficiency);
- use a variety of instructional strategies (e.g., extensive use of visual cues, graphic organizers, scaffolding, previewing textbooks, pre-teaching key vocabulary, peer tutoring, strategic use of students' first languages);
- provide a variety of learning resources (e.g., visual material, simplified text, bilingual dictionaries, and culturally diverse materials);
- make accommodations for assessment (e.g., granting extra time, use of oral interviews and tasks requiring completion of graphic organizers and cloze sentences instead of essay questions and other assessment tasks that depend heavily on proficiency in English).

Students who are no longer taking ESL or ELD courses may still require program adaptations to be successful. When learning expectations in a course other than ESL and ELD are modified, or accommodations to the learning environment are made, this must be clearly indicated on the student's report card by checking the ESL or ELD box. (See *Guide to the Provincial Report Card, Grades 9–12*, 1999.)

For further information on supporting ESL and ELD students, refer to *The Ontario Curriculum, Grades 9 to 12, English As a Second Language and English Literacy Development*, 1999.

Career Education

Expectations in the LDCC Science courses include many opportunities for students to apply their scientific skills to work-related situations, to explore educational and career options, and to become self-directed learners. Literacy, mathematical literacy, and interpersonal skills are essential skills for the workplace and will equip students to manage information technologies, communicate effectively and correctly in a variety of situations, and perform a variety of tasks. Small-group work and oral presentations help students to express themselves confidently and to work cooperatively with others.

Cooperative Education and Other Workplace Experiences

Experiential, community-based activities, such as job shadowing, work experience, and cooperative education help students develop learning and interpersonal skills as well as identify their educational and career interests. Students develop the knowledge and skills that are necessary for success in today's workplace. Through these activities, students have the opportunity to practise, in an authentic environment, workplace skills such as literacy and numeracy, and interpersonal and personal management skills. The Ontario Curriculum, Guidance and Career Education, Grade 10 course, *Discovering the Workplace*, will help students identify early in their secondary school career the Essential Skills and work habits that are required for success in the workplace, and will prepare them for work experiences in the community.

Antidiscrimination Education

The LDCC curriculum is designed to help students acquire the “habits of mind” essential in a complex democratic society characterized by rapid technological, economic, political, and social change. Students are expected to demonstrate a willingness to show respect, tolerance, and understanding towards individuals, groups, and cultures in the global community, as well as show respect and responsibility for the environment. These attitudes, including understanding the importance of protecting the rights of others, and taking a stand against racism and other expressions of hatred and discrimination, are modelled in the classroom and prepare students for their future roles at home, at work, and in the community.

The learning activities and materials used to teach the curriculum should be inclusive in nature, and should reflect various points of view and experiences, including the Aboriginal perspectives. This will enable all students to become more sensitive to the experiences and perceptions of others. Curriculum activities should also strengthen students' abilities to recognize bias and stereotypes in contemporary as well as in historical portrayals, viewpoints, representations, and images.

Health and Safety

Teachers are responsible for ensuring the safety of students during classroom activities and for teaching students to assume responsibility for their own and others' safety. They must model safe practices and communicate safety expectations to students in accordance with school board and ministry policies. This concern for safety in science requires that students demonstrate:

- knowledge about the materials, tools, processes, and procedures used in science;
- skill in performing tasks in the laboratory;
- knowledge about health and safety concerns and about the care of living things (plants and animals) that are brought into the classroom;
- concern for the health and safety of self and others.

Students demonstrate the knowledge, skills, and habits of mind required for safe involvement in science when, for example, they:

- maintain a well-organized and uncluttered work space;
- carefully follow the instructions and example of the teacher;
- identify possible health and safety concerns;
- follow established safety procedures;
- suggest and implement appropriate safety procedures in new situations;
- comply with Workplace Hazardous Materials Information System (WHMIS) legislation.

Course Description

This course emphasizes reinforcing and strengthening science-related knowledge and skills, including scientific inquiry, critical thinking, and the relationship between science, society, and the environment, to prepare students for success in everyday life, in the workplace, and in the Science Grade 11 Workplace Preparation course.

Students explore a range of topics, including science in daily life, properties of common materials, life-sustaining processes in simple and complex organisms, and electrical circuits.

Students have the opportunity to extend mathematical and scientific process skills and to continue developing their skills in reading, writing, and oral language through relevant and practical science activities.

Prerequisite: None

Scientific Inquiry: Science in Daily Life

Overall Expectations

By the end of this course, students will:

SILV.01 • illustrate how science is a part of daily life;

SILV.02 • use appropriate scientific skills, tools, and safety procedures to investigate problems;

SILV.03 • examine the connections between science and activities in daily life.

Specific Expectations

Understanding Basic Concepts

By the end of this course, students will:

SIL1.01 – describe how the procedures, skills, and tools employed in different areas of science are also evident in daily life (e.g., microscopes and balances, the use of statistical evidence to make decisions);

SIL1.02 – explain the importance of a “fair test” for troubleshooting and testing everyday science problems (e.g., diagnosing computer problems, repairing automobiles, testing faulty electrical circuits, determining safety of consumer products).

Developing Skills of Inquiry and Communication

By the end of this course, students will:

SIL2.01 – formulate questions about problems or issues that can be scientifically tested (e.g., Which paper airplane flies the farthest or fastest? Which metal retains more heat? Which colour/brand of hair dye lasts the longest? Which pair of sunglasses are the best filters of the sun’s rays? Which location enables us to see the stars most clearly at night?);

SIL2.02 – plan, conduct, and refine simple investigations to answer student-generated questions;

SIL2.03 – conduct investigations safely, using appropriate lab equipment (e.g., use scales, rulers, voltmeter/ammeter, stopwatch for making measurements);

SIL2.04 – observe and record data, using a variety of formats (e.g., diagrams, data tables, webs, graphic organizers, using computers, as appropriate); including the use of SI units, where appropriate;

SIL2.05 – assess data to make inferences and conclusions and to answer questions and refine procedures;

SIL2.06 – communicate plans, observations, and results using a variety of oral, written, and graphic representations, and including the use of SI units, where appropriate (e.g., tables, charts, journals, using a variety of technologies).

Relating Science to Technology, Society, and the Environment

By the end of this course, students will:

SIL3.01 – develop and investigate research questions about an everyday science-related topic of personal interest (e.g., Which skateboard wheels are the fastest? Which snack bar is the most nutritious? Which ball retains its bounce the longest, or bounces the highest? Which light bulbs last the longest? What paper towel is the most absorbent? What effect do the sun’s patterns have on the activities in my community?);

SIL3.02 – evaluate the investigation of the topic they selected and suggest possible refinements;

SIL3.03 – demonstrate an understanding of how problem-solving and decision-making activities in the workplace use scientific process skills (e.g., sampling, researching, recording).

Chemistry: Properties of Common Materials

Overall Expectations

By the end of this course, students will:

CPMV.01 • explain the characteristics and classification of common materials, using appropriate scientific terminology;

CPMV.02 • investigate the physical and chemical properties of common materials through laboratory activities;

CPMV.03 • analyse how the use of various materials is based on their physical and chemical properties.

Specific Expectations

Understanding Basic Concepts

By the end of this course, students will:

CPM1.01 – recognize the symbols used to classify hazardous materials at home and in the workplace (HHPs, WHMIS);

CPM1.02 – outline the hazards of common materials (e.g., bleach, drain cleaner, burning plastics) associated with safe and unsafe use;

CPM1.03 – explain the characteristics of pure substances and mixtures, using appropriate scientific terminology;

CPM1.04 – describe the physical properties (e.g., texture, lustre, solubility, clarity, colour, state, electrical conductivity) of common materials (e.g., paints, solvents, metals), using appropriate scientific terminology;

CPM1.05 – describe the chemical properties (e.g., flammability, reactivity, reaction in water, reaction in acids, reaction with pH test strips) of common materials (e.g., paints, solvents, metals), using appropriate scientific terminology.

Developing Skills of Inquiry and Communication

By the end of this course, students will:

CPM2.01 – plan and conduct investigations on the physical and chemical properties of substances, using lab equipment and materials safely and accurately (e.g., test metals to observe state, appearance, strength, flexibility, heat, and electrical conductivity; test materials for their reaction with acids, water, salt solutions);

CPM2.02 – use appropriate laboratory safety and disposal procedures while conducting investigations (e.g., wear safety glasses, practise orderliness and cleanliness, follow WHMIS guidelines and emergency procedures, use proper procedures for handling and disposal);

CPM2.03 – organize and record the observations of the investigations, using appropriate formats (e.g., charts, tables, diagrams, graphs, science journals);

CPM2.04 – interpret and communicate the results of investigations (e.g., classify the materials tested, write conclusions).

Relating Science to Technology, Society, and the Environment

By the end of this course, students will:

CPM3.01 – investigate the physical and chemical properties of the component materials of two similar products (e.g., hair mousse, toothpastes, skateboards, backpacks, running shoes, building materials, electrical materials);

CPM3.02 – compare the physical and chemical properties of the materials investigated and relate these properties to how they are used (e.g., the flexibility and strength of wood and carbon fibre to their use in hockey sticks; heat conductivity in metals to their use in pots and pans; solubility of materials to their use in make-up);

CPM3.03 – present a recommendation (e.g., oral presentation, product label, product information sheet, annotated diagram, advertisement), based on the results of the investigation and the research of the product, appropriate for someone interested in using the product (e.g., hairstylist, hockey player, sportswear manufacturer, welder).

Biology: Staying Alive

Overall Expectations

By the end of this course, students will:

BSAV.01 • explain the systems and processes required by simple and complex organisms to sustain life;

BSAV.02 • investigate, through laboratory activities, the processes which simple and complex organisms use to sustain life;

BSAV.03 • analyse how personal health and safety in everyday life and in the workplace are protected through the proper use of equipment and safety practices.

Specific Expectations

Understanding Basic Concepts

By the end of this course, students will:

BSA1.01 – describe the basic life-sustaining processes of organisms, including single-celled and complex organisms (e.g., ingestion of food, waste removal, gas exchange, material transport, response to environmental stimuli, reproduction), using appropriate scientific vocabulary;

BSA1.02 – relate structures involved in life-sustaining processes to their function (e.g., nucleus and reproduction, membranes and diffusion, components of respiratory system to gas exchange);

BSA1.03 – outline how a complex organism functions through the basic interactions between organ systems (e.g., connection between respiratory and circulatory system in animals, between roots and leaves in plants).

Developing Skills of Inquiry and Communication

By the end of this course, students will:

BSA2.01 – formulate questions and plan simple experiments to investigate how simple and complex organisms respond to environmental stimuli (e.g., earthworm responses to light, plant response to gravity or light, mimosa plant response to touch, Euglena response to light, eye response to light, production of saliva);

BSA2.02 – make accurate observations of structures, using microscopes, and relate them to functions of systems and processes of simple and complex organisms (e.g., feeding behaviour of protists, circulatory system of Daphnia, budding of yeast cells, chloroplasts in plant cells, breathing in fish);

BSA2.03 – examine the relationship between the circulatory, respiratory, and digestive systems in complex organisms by performing dissections or using a computer-simulated dissection (e.g., earthworm, fish, grasshopper, frog);

BSA2.04 – extract and interpret information from a variety of sources (e.g., informational texts, lab instructions, Internet, electronic databases);

BSA2.05 – communicate observations, interpretation of results, and information through appropriate formats (e.g., diagrams, graphs, group discussions, and written work).

Relating Science to Technology, Society, and the Environment

By the end of this course, students will:

BSA3.01 – analyse how specific equipment and safe practices are used to protect personal health and safety at home and in the workplace (e.g., how protective gloves prevent absorption of harmful chemicals into the circulatory system; how controlling the growth or removing harmful microbes from food by refrigeration or cooking protects against ingestion of harmful bacteria; how a space suit/scuba gear support the respiratory system);

BSA3.02 – examine case studies of common workplace environments to develop a checklist of safety practices necessary to sustain systems and processes critical to life (e.g., safety practices when spray painting, preparing food, working in an auto shop, applying pesticides, working in a mine).

Physics: Electrical Circuits

Overall Expectations

By the end of this course, students will:

PECV.01 • describe the characteristics of electrical circuits;

PECV.02 • investigate simple electrical circuits, using safe practices;

PECV.03 • analyse the practical uses of electrical circuits and their impact on daily life.

Specific Expectations

Understanding Basic Concepts

By the end of this course, students will:

PEC1.01 – use scientific terminology during investigations to describe basic electrical concepts and related units of measure (e.g., current – ampere, potential difference – volts, source, load, open and closed circuit, conductor, insulator);

PEC1.02 – demonstrate an understanding that electrical energy can be converted into other forms of usable energy within electrical circuits (e.g., heat, light, motion);

PEC1.03 – identify how household and workplace electrical devices operate by converting energy to another form (e.g., electrical energy to light energy in a bulb, flashlight; electrical energy to heat energy in a stove, electric heater, and heat lamps; chemical energy to electrical energy in a battery; electrical energy to motion in a power saw and analog watch);

PEC1.04 – use a variety of symbols to represent different components in electrical circuits (e.g., ammeter, wire, switch, power source, load, voltmeter).

Developing Skills of Inquiry and Communication

By the end of this course, students will:

PEC2.01 – formulate scientific questions about circuits and create a simple plan to carry out an investigation, including safety procedures (e.g., How do series and parallel circuit of bulbs work differently? What is the effect of increasing the number of batteries in series or parallel in a circuit? How can a circuit be turned off at two different locations? What is the effect of increasing the number of loads in a circuit?);

PEC2.02 – design, build, and test an electrical circuit to investigate the chosen question, using appropriate safety procedures;

PEC2.03 – conduct investigations, using electrical materials, tools, and equipment safely;

PEC2.04 – measure and record the current and potential difference in simple circuits through the safe and proper use of an ammeter and a voltmeter;

PEC2.05 – extract and interpret information from instructions and manuals for circuits and electrical devices (e.g., explain a circuit diagram to a peer);

PEC2.06 – communicate plans and results of investigations about electrical circuits, using a variety of oral, written, and graphic formats.

Relating Science to Technology, Society, and the Environment

By the end of this course students will:

PEC3.01 – identify circuits and their components in household and workplace settings (e.g., fuses, circuit breakers, switches, loads in appliances, electronic equipment, household wiring, handheld tools);

PEC3.02 – develop a logical checklist to troubleshoot an electrical device of personal choice (e.g., CD or DVD player, hair dryer or curling iron, VCR, electric floor cleaner, electronic balance, calculator, toaster, flashlight, electric drill).

Course Description

This course emphasizes reinforcing and strengthening science-related knowledge and skills, including scientific inquiry, critical thinking, and the environmental impact of science and technology, to prepare students for success in everyday life, in the workplace, and in the Science Grade 11 Workplace Preparation course.

Students explore a range of topics, including science in the media, interactions of common materials, interdependence of organisms in communities, and using electrical energy.

Students have the opportunity to extend mathematical and scientific process skills and to continue developing their skills in reading, writing, and oral language through relevant and practical science activities.

Prerequisite: None

Scientific Inquiry: Science in Media

Overall Expectations

By the end of this course, students will:

- SIMV.01** • explain how science-related information is presented in print and electronic media for different purposes and audiences;
- SIMV.02** • investigate science-related information presented in print and electronic media using appropriate research and reporting skills;
- SIMV.03** • evaluate claims and presentations of science-related information in media.

Specific Expectations

Understanding Basic Concepts

By the end of this course, students will:

- SIM1.01** – identify the ways in which scientific information is conveyed (e.g., product labels; graphic text in billboards, newspapers, instructions; graphs and tables in magazines, TV, posters; visual images in print and electronic media; vocabulary and dialogue in radio advertising or movies);
- SIM1.02** – discuss, using examples, how the method of presenting scientific information connects to the purpose (e.g., find and compare examples used for promotion, persuasion, education, entertainment);
- SIM1.03** – explain how different formats used in the media to present science information target specific audiences (e.g., graphs and charts in health-related advertising, statistics on car performance, simplified vocabulary in movies, diagrams in newspapers).

Developing Skills of Inquiry and Communication

By the end of this course, students will:

- SIM2.01** – formulate testable questions on science-related claims and conduct investigations based on the concept of a fair test (e.g., testing cleaning power of detergents or shampoos, lasting power of “waterproof” mascara, durability of skateboard wheels, water absorption by diapers);
- SIM2.02** – research science-related information from a variety of electronic and other sources;
- SIM2.03** – interpret research data, including analysis for accuracy and bias as appropriate, using a range of strategies for reading for information;
- SIM2.04** – organize and communicate information collected from lab investigations and information research using graphic organizers.

Relating Science to Technology, Society, and the Environment

By the end of this course, students will:

- SIM3.01** – formulate testable questions about science-related claims and representations in the media (e.g., advertising in print or on TV, information provided in a movie or TV show or website, science information used in magazine or newspaper stories);
- SIM3.02** – develop procedures to assess these claims and representations, using information research and/or laboratory investigations;
- SIM3.03** – evaluate the investigation and suggest improvements (e.g., present and defend their findings);
- SIM3.04** – communicate science-related information to a workplace audience (e.g., hand-washing reminder, safe handling of cleaning chemicals, precautions for use of electrical devices) by creating a media work (e.g., webpage, poster, television commercial).

Chemistry: Interactions of Common Materials

Overall Expectations

By the end of this course, students will:

CIMV.01 • understand how chemicals in common household and workplace materials interact;

CIMV.02 • investigate the types and rates of interactions between commonly used materials through laboratory activities;

CIMV.03 • analyse how material interactions affect our daily lives.

Specific Expectations

Understanding Basic Concepts

By the end of this course, students will:

CIM1.01 – recognize the relationships among chemical formulae, composition, and common names (e.g., HCl(aq), hydrochloric acid, muriatic acid);

CIM1.02 – classify chemicals into groups according to their behaviour (e.g., acids, bases, fuels, oxidizers), using appropriate scientific terminology;

CIM1.03 – distinguish between chemical reactions (e.g., burning paper, reacting metals with acids) and physical processes (e.g., crumpling paper, making and diluting solutions), using appropriate scientific terminology (e.g., reactants, products, change of state, concentration, solute, solvent);

CIM1.04 – identify the factors that alter the rate of physical processes and chemical reactions (e.g., temperature, surface area, concentration, presence of a catalyst/inhibitor).

Developing Skills of Inquiry and Communication

By the end of this course, students will:

CIM2.01 – select and use appropriate lab equipment and apply WHMIS safety procedures for the handling, storage, disposal, and recycling of laboratory materials;

CIM2.02 – conduct experiments to investigate how materials can interact chemically (e.g., combine steel wool with oxygen, neutralize an acid with a base, combine copper chloride and aluminum foil);

CIM2.03 – conduct experiments to investigate how materials can interact physically (e.g., calculate amounts needed for solutions, prepare and dilute solutions, prepare gels, foams, evaporate alcohol and water);

CIM2.04 – conduct experiments to determine the factors affecting rates of chemical reactions and physical processes (e.g., temperature, surface area, concentration, presence of a catalyst/inhibitor);

CIM2.05 – communicate the results of investigations using a variety of oral, written and graphic formats.

Relating Science to Technology, Society, and the Environment

By the end of this course, students will:

CIM3.01 – research the interactions of materials that are used in daily life (e.g., hair or clothing dye, cleaning solvents, paints, fuels, silage, pesticides and herbicides, plastics);

CIM3.02 – analyse the costs and benefits of a specific material with reference to its interactions with other materials in the environment (e.g., solvents: flammability versus use in dry cleaning; plastics: light weight and can be formed into many different products versus hazardous when burned);

CIM3.03 – communicate an opinion, supported by evidence, about the use of a particular material, with consideration for both its physical and chemical interactions (e.g., plastic containers for food storage, latex paint for household exteriors, vinegar as cleaning agent, butane lighters, alternative materials for car body repair).

Biology: Living Together

Overall Expectations

By the end of this course, students will:

- BLTV.01** • explain the strategies that organisms use for successful coexistence in populations and communities;
- BLTV.02** • investigate, using appropriate laboratory and research skills, the implications of organisms existing in communities;
- BLTV.03** • analyse the challenges that arise from organisms living in communities.

Specific Expectations

Understanding Basic Concepts

By the end of this course, students will:

- BLT1.01** – summarize the potential benefits of organisms living together in communities (e.g., protection, shared food supply, sharing of resources, improved hunting success and nurturing of young);
- BLT1.02** – identify challenges that arise from organisms living together in communities, including human populations (e.g., maintaining the balance of nature, competition between individuals for limited resources, pollution due to waste production, spreading of disease);
- BLT1.03** – compare the strategies used by various communities of organisms to successfully coexist (e.g., social organization of insects or animals that may include division of labour, communication, and co-operation; plantation tree growth in limited space);
- BLT1.04** – use appropriate scientific terminology related to concepts of organisms living together (e.g., species, population, community, colony, biodiversity).

Developing Skills of Inquiry and Communication

By the end of this course, students will:

- BLT2.01** – plan and conduct an experiment to investigate the results of over crowding in microscopic populations (e.g., growing yeast populations, non-pathogenic bacteria cultures), including estimation and measurement of population size;
- BLT2.02** – plan and conduct an experiment to investigate the results of over crowding in macroscopic populations (e.g., growing plants in close proximity, fruit fly culture) including measuring rate of growth of population size;
- BLT2.03** – make accurate observations of the organisms that exist in a community (e.g., pond water), using a microscope;

BLT2.04 – make observations, directly or using technologies, to determine the benefits and challenges of living in communities (e.g., observe social structure in an ant colony, examine fruit fly populations, whale pods, wolf packs, meerkat communities, human populations);

BLT2.05 – use a variety of research strategies to determine the roles of specific organisms within a community (e.g., different roles found in bee communities, in lion prides, schools of fish, migrating birds);

BLT2.06 – explain and interpret observations by summarizing patterns obtained from graphing data, organizing information, and communicating orally and in writing.

Relating Science to Technology, Society, and the Environment

By the end of this course, students will:

- BLT3.01** – develop a simple action plan, using a consistent written format, to address an environmental concern (e.g., to conduct school recycling program that addresses waste management; to promote car-pooling or public transit to reduce air pollution; to practise conservation during fishing and hunting to maintain animal populations; to operate a composter successfully; to manage a school garden to maintain plant populations; to participate in community or national data collection projects such as bird, insect, or tree population surveys);
- BLT3.02** – determine, through a case study, and explain how humans organize their communities to address challenges of living together (e.g., waste management in a workplace, regulations on water treatment, disease control, smoking, responsibilities within a school or community for conservation of resources, operation of a local food bank, by-laws on the use of herbicides).

Physics: Using Electrical Energy

Overall Expectations

By the end of this course, students will:

PEEV.01 • explain the generation, measurement, and conversion of electricity;

PEEV.02 • investigate the factors that affect the generation and use of electricity;

PEEV.03 • analyse the social, economic, and/or environmental implications of the sources and uses of electrical energy.

Specific Expectations

Understanding Basic Concepts

By the end of this course, students will:

PEE1.01 – describe different methods of generating electricity from other forms of energy (e.g., batteries, hydro, solar);

PEE1.02 – define and describe electrical concepts (e.g., amps, volts, current, potential difference, energy and power) and their units (e.g., kWh, joules, watts);

PEE1.03 – determine quantitatively and/or qualitatively the energy and power associated with electrical devices (calculate energy use using time and power rating on appliance, measure output of voltaic cell);

PEE1.04 – identify the range of uses for electrical energy in our society and the energy conversions involved (e.g., heating, labour-saving devices in the home and workplace, transportation, lighting, entertainment, communications).

PEE2.05 – communicate information using appropriate formats for specific purposes and audiences (e.g., orally explain the electrical device, use a table or chart for measurement, create a diagram for design).

Relating Science to Technology, Society, and the Environment

By the end of the course, students will:

PEE3.01 – compare technologies used for generating electrical energy, including their social, economic, or environmental implications (e.g., advantages and disadvantages of batteries, hydro, solar, coal, wind, nuclear);

PEE3.02 – design and implement a plan to reduce electrical consumption at home, at school, or in a workplace, based on identified consumption patterns.

Developing Skills of Inquiry and Communication

By the end of this course, students will:

PEE2.01 – locate and select information from various sources (e.g., print, electronic, community resources and personally collected information) to identify factors affecting generation and use of electricity;

PEE2.02 – design and build an electrical device (e.g., a voltaic cell, a coil of wire, and a moving magnet; a windmill/waterwheel connected to a generator), using lab equipment and materials safely;

PEE2.03 – modify the electrical device they built to increase the amount of electrical energy it produces;

PEE2.04 – determine and record the electrical energy and power of electrical devices;